

1. PUBLIC HEALTH STATEMENT

This public health statement tells you about vinyl chloride and the effects of exposure.

The Environmental Protection Agency (EPA) identifies the most serious hazardous waste sites in the nation. These sites make up the National Priorities List (NPL) and are the sites targeted for long-term federal cleanup. Vinyl chloride has been found in at least 496 of the 1,430 current or former NPL sites. However, it's unknown how many NPL sites have been evaluated for this substance. As more sites are evaluated, the sites with vinyl chloride may increase. This is important because exposure to this substance may harm you and because these sites may be sources of exposure.

When a substance is released from a large area, such as an industrial plant, or from a container, such as a drum or bottle, it enters the environment. This release does not always lead to exposure. You are exposed to a substance only when you come in contact with it by breathing, eating, touching, or drinking.

If you are exposed to vinyl chloride, many factors will determine whether you'll be harmed. These factors include the dose (how much), the duration (how long), and how you come in contact with it. You must also consider the other chemicals you're exposed to and your age, sex, diet, family traits, lifestyle, and state of health.

1.1 WHAT IS VINYL CHLORIDE?

Vinyl chloride is a colorless gas at normal temperatures. It is also known as chloroethene, chloroethylene, ethylene monochloride, or monochloroethylene. It is flammable (burns easily) as a gas and is not stable at high temperatures. Vinyl chloride exists in liquid form if it is kept under high pressure or at low temperatures (less than -13.4°C). Vinyl chloride has a mild, sweet odor. Most people begin to smell vinyl chloride in the air at 3,000 parts vinyl chloride per million parts (ppm) of air. However, the odor is of no value in preventing excess exposure. Most people begin to taste vinyl chloride in water at 3.4 ppm.

1. PUBLIC HEALTH STATEMENT

All vinyl chloride is manufactured or results from the breakdown of other manufactured substances, such as trichloroethylene, trichloroethane, and tetrachloroethylene. Production of vinyl chloride in the United States has grown at an average rate of 7% from the early 1980s to the early 1990s with an additional increase of approximately 22% between the years 1992 and 1993. Most of the vinyl chloride produced in the United States is used to make polyvinyl chloride (PVC). PVC is used to make a variety of plastic products including pipes, wire and cable coatings, and packaging materials. Other uses include furniture and automobile upholstery, wall coverings, housewares, and automotive parts. At one time, vinyl chloride was also used as a coolant, as a propellant in spray cans, and in some cosmetics. Since the mid-1970s it has not been used for these purposes. Please refer to Chapter 3 for more information on the chemical and physical properties of vinyl chloride. For more information on the production and use of vinyl chloride, see Chapter 4.

1.2 WHAT HAPPENS TO VINYL CHLORIDE WHEN IT ENTERS THE ENVIRONMENT?

Most of the vinyl chloride that enters the environment comes from the plastics industries, which release it into the air or into wastewater. EPA limits the amount that industries may release. Vinyl chloride is also a breakdown product of other synthetic chemicals in the environment. Vinyl chloride has entered the environment at hazardous waste sites as a result of its improper disposal or leakage from storage containers or from spills, but some may be from the breakdown of other chemicals. Vinyl chloride has been found in tobacco smoke, perhaps as a result of the manufacturing process.

Liquid vinyl chloride evaporates easily into the air. Vinyl chloride in water or soil evaporates rapidly if it is near the surface. Vinyl chloride in the air breaks down in a few days. When vinyl chloride breaks down in air, it can form other harmful chemicals.

A limited amount of vinyl chloride can dissolve in water. It can enter groundwater and can also be found in groundwater from the breakdown of other chemicals. It is unlikely that vinyl chloride will build up in plants or animals that you might eat. For more information on what happens to vinyl chloride in the environment, please see Chapters 4 and 5.

1. PUBLIC HEALTH STATEMENT

1.3 HOW MIGHT I BE EXPOSED TO VINYL CHLORIDE?

Since vinyl chloride commonly exists in a gaseous state, you are most likely to be exposed to it by breathing it. Vinyl chloride is not normally found in urban, suburban, or rural air in amounts that are detectable by the usual methods of analysis. However, vinyl chloride has been found in the air near plastics industries, hazardous waste sites, and landfills. The amount of vinyl chloride in the air near these places ranges from trace amounts to 0.041 ppm of air but may exceed 1 ppm. Levels as high as 44 ppm have been found in the air at some landfills. One can also be exposed to vinyl chloride in the air through tobacco smoke from cigarettes or cigars.

You may also be exposed to vinyl chloride by drinking water from contaminated wells, but how often this occurs is not known. Most drinking water supplies do not contain vinyl chloride. In a 1982 survey, vinyl chloride was found in less than 1% of the 945 groundwater supplies tested in the United States. The concentrations found in groundwater were up to 0.008 ppm, with a detection limit of 0.001 ppm. Other studies have reported groundwater vinyl chloride concentrations at or below 0.38 ppm. At one time, the flow of water through PVC pipes added very low amounts of vinyl chloride to water. For example, in one study of newly installed pipes, the drinking water had 0.001 ppm of vinyl chloride. No current information on the amount of vinyl chloride released from PVC pipes into water is available. In the past, vinyl chloride could get into food that was stored in materials that contained PVC. Now the U.S. government regulates the amount of vinyl chloride in food packaging materials. It has been estimated that when levels less than 1 ppm of vinyl chloride are used in PVC packaging, vinyl chloride in detectable amounts does not enter food by contact with these products.

Exposure to vinyl chloride can also occur in the workplace by breathing in any vapors in the air. Based on studies using animals, it is possible that if vinyl chloride comes into contact with your skin or eyes, extremely small amounts could enter your body. People who are exposed to vinyl chloride at their workplace include workers who make vinyl chloride and PVC.

Please refer to Chapter 5 for more information on ways that people are exposed to vinyl chloride.

1. PUBLIC HEALTH STATEMENT

1.4 HOW CAN VINYL CHLORIDE ENTER AND LEAVE MY BODY?

If vinyl chloride comes into contact with your skin, negligible amounts may pass through the skin and enter your body. Vinyl chloride is more likely to enter your body when you breathe air or drink water containing it. This could occur near certain factories or hazardous waste sites or in the workplace. Most of the vinyl chloride that you breathe or swallow enters your blood rapidly. The vinyl chloride in your blood travels through your body. When some portion of it reaches your liver, it is changed into several substances. Most of these new substances also travel in your blood. Once they reach your kidneys, they leave your body in your urine. Most of the vinyl chloride is gone from your body a day after you breathe or swallow it. The liver, however, makes some new substances that do not leave your body as rapidly. A few of these new substances are more harmful than vinyl chloride because they react with chemicals inside your body and interfere with the way your body normally uses or responds to these chemicals. Some of these substances react in the liver and, depending on how much vinyl chloride you breathe in, may cause damage there. It takes more time for your body to get rid of these changed chemicals, but eventually your body will remove them as well. If you breathe or swallow more vinyl chloride than your liver can chemically change, you will breathe out excess vinyl chloride. Chapter 2 contains more information on how vinyl chloride enters and leaves your body.

1.5 HOW CAN VINYL CHLORIDE AFFECT MY HEALTH?

To protect the public from the harmful effects of toxic chemicals and to find ways to treat people who have been harmed, scientists use many tests.

One way to see if a chemical will hurt people is to learn how the chemical is absorbed, used, and released by the body; for some chemicals, animal testing may be necessary. Animal testing may also be used to identify health effects such as cancer or birth defects. Without laboratory animals, scientists would lose a basic method to get information needed to make wise decisions to protect public health. Scientists have the responsibility to treat research animals with care and compassion. Laws today protect the welfare of research animals, and scientists must comply with strict animal care guidelines.

1. PUBLIC HEALTH STATEMENT

If you breathe high levels of vinyl chloride, you will feel dizzy or sleepy. These effects occur within 5 minutes if you are exposed to about 10,000 ppm of vinyl chloride. You can easily smell vinyl chloride at this concentration. If you breathe still higher levels, you may pass out. You can rapidly recover from these effects if you breathe fresh air. Some people get a headache when they breathe fresh air immediately after breathing very high levels of vinyl chloride. People may die if they breathe extremely high levels of vinyl chloride. These levels are much higher than the levels that cause you to pass out. Studies in animals show that extremely high levels of vinyl chloride can damage the liver, lungs, and kidneys. These levels can also damage the heart and prevent blood clotting. The effects of ingesting vinyl chloride are unknown. If you spill liquid vinyl chloride on your skin, it will numb the skin and cause redness and blisters.

Some people who have breathed vinyl chloride for several years have changes in the structure of their livers. People are more likely to develop these changes if they breathe high levels of vinyl chloride. Some people who have worked with vinyl chloride have nerve damage, and others have developed an immune reaction. The lowest levels that cause liver changes, nerve damage, and the immune reaction in humans are not known. Certain jobs related to PVC production expose workers to very high levels of vinyl chloride. Some of these workers have problems with the blood flow in their hands. Their fingers turn white and hurt when they go into the cold. It may take a long time to recover when they go into a warm place. In some of these people, changes have appeared on the skin of their hands and forearms. Also, bones at the tips of their fingers have broken down. Studies suggest that some people may be more sensitive to these effects than others.

Some men who work with vinyl chloride have complained of a lack of sex drive. Studies in animals showed that long-term exposure may damage the sperm and testes. Some women who work with vinyl chloride have reported irregular menstrual periods. Some have developed high blood pressure during pregnancy. Studies of women who live near vinyl chloride manufacturing plants did not show that vinyl chloride causes birth defects. Studies using pregnant animals showed that breathing high levels of vinyl chloride may harm unborn offspring. Animal studies also show that vinyl chloride may cause increased numbers of miscarriages early in pregnancy. It may also cause decreased weight and delayed skeletal development in fetuses. The same very high levels of vinyl chloride that caused these fetal effects also caused adverse effects in the pregnant animals.

1. PUBLIC HEALTH STATEMENT

Results from several studies have suggested that breathing air or drinking water containing low levels of vinyl chloride may increase the risk of getting cancer. However, the levels used in these studies were much higher than those found in the ambient air and/or most drinking water supplies. Studies of workers who have breathed vinyl chloride over many years showed increased risk of getting cancer of the liver. Brain cancer, lung cancer, and some cancers of the blood also may be connected with breathing vinyl chloride over long periods. Studies of long-term exposure in animals showed that increases in cancer of the liver and mammary gland may occur at very low levels of vinyl chloride in the air. Studies have shown that animals fed low levels of vinyl chloride each day during their lifetime had an increased risk of getting liver cancer.

The Department of Health and Human Services (DHHS) has determined that vinyl chloride is a known carcinogen. The International Agency for Research on Cancer (IARC) has determined that vinyl chloride is carcinogenic to humans, and EPA has determined that vinyl chloride is a human carcinogen.

More information on the health effects of vinyl chloride in humans and animals can be found in Chapter 2.

I.6 IS THERE A MEDICAL TEST TO DETERMINE WHETHER I HAVE BEEN EXPOSED TO VINYL CHLORIDE?

The results of several tests can sometimes show if you have been exposed to vinyl chloride, depending on the amount of your exposure and how recently it happened. However, scientists do not know if these measurements can tell how much vinyl chloride you have been exposed to. These tests are not normally available at your doctor's office. Vinyl chloride can be measured in your breath, but the test must be done shortly after exposure. This test is not very helpful for measuring very low levels of the chemical. The amount of the major breakdown product of vinyl chloride, thiodiglycolic acid, in the urine may give some information about exposure. However, this test must be done shortly after exposure and is not a reliable indicator of the level of exposure. Also, exposure to other chemicals can produce the same breakdown products in your urine. Vinyl chloride can bind to genetic material in your body. The amount of this binding can be measured by sampling your blood or tissue. This measurement will give information about whether you have been exposed to vinyl chloride, but it is

1. PUBLIC HEALTH STATEMENT

not sensitive enough to determine the effects on the genetic material resulting from exposure. For more information, see Chapters 2 and 6.

1.7 WHAT RECOMMENDATIONS HAS THE FEDERAL GOVERNMENT MADE TO PROTECT HUMAN HEALTH?

The federal government develops regulations and recommendations to protect public health. Regulations can be enforced by law. Federal agencies that develop regulations for toxic substances include the Environmental Protection Agency (EPA), the Occupational Safety and Health Administration (OSHA), and the Food and Drug Administration (FDA). Recommendations provide valuable guidelines to protect public health but cannot be enforced by law. Federal organizations that develop recommendations for toxic substances include the Agency for Toxic Substances and Disease Registry (ATSDR) and the National Institute for Occupational Safety and Health (NIOSH).

Regulations and recommendations can be expressed in not-to-exceed levels in air, water, soil, or food that are usually based on levels that affect animals; then they are adjusted to help protect people. Sometimes these not-to-exceed levels differ among federal organizations because of different exposure times (an 8-hour workday or a 24-hour day), the use of different animal studies, or other factors.

Recommendations and regulations are also periodically updated as more information becomes available. For the most current information, check with the federal agency or organization that provides it. Some regulations and recommendations for vinyl chloride include the following:

Vinyl chloride is regulated in drinking water, food, and air. Because it is a hazardous substance, regulations on its disposal, packaging, and other forms of handling also exist. EPA requires that the amount of vinyl chloride in drinking water not exceed 0.002 milligrams per liter (mg/L) of water (0.002 ppm). Under the EPA's Ambient Water Quality Criteria (AWQC) for the protection of human health, a concentration of zero has been recommended for vinyl chloride in ambient water.

In order to limit intake of vinyl chloride through foods to levels considered safe, the FDA regulates the vinyl chloride content of various plastics. These include plastics that carry liquids and plastics that come into contact with food. The limits for vinyl chloride content vary depending on the nature of the plastic and its use.

1. PUBLIC HEALTH STATEMENT

EPA has named vinyl chloride as a hazardous part of solid waste. If quantities greater than 1 pound (0.454 kilograms [kg]) are released to the environment, the National Response Center of the federal government must be told within 24 hours of the release.

OSHA regulates levels of vinyl chloride in the workplace. The maximum allowable amount of vinyl chloride in workroom air during an 8-hour workday in a 40-hour workweek is 1 ppm. The maximum amount allowed in any 15-minute period is 5 ppm. NIOSH recommends that the exposure limit (for a time-weighted average [TWA]) for vinyl chloride in air be the lowest reliably detectable concentration. Workers exposed to any measurable amount of it must wear special breathing equipment. EPA sets emission standards for vinyl chloride and PVC plants. The amount of vinyl chloride allowed to be emitted varies depending on the type of production and discharge system used.

Further regulations and guidelines that apply to vinyl chloride are presented in Chapter 7.

1.8 WHERE CAN I GET MORE INFORMATION?

If you have any more questions or concerns, please contact your community or state health or environmental quality department or:

Agency for Toxic Substances and Disease Registry
Division of Toxicology
1600 Clifton Road NE, Mailstop E-29
Atlanta, Georgia 30333

*Information line and technical assistance

Phone: (404) 639-6000
Fax: (404) 639-6315 or 6324

ATSDR can also tell you the location of occupational and environmental health clinics. These clinics specialize in recognizing, evaluating, and treating illnesses resulting from exposure to hazardous substances.

1. PUBLIC HEALTH STATEMENT

*To order toxicological profiles, contact:

National Technical Information Service
5285 Port Royal Road
Springfield, VA 22161
Phone (800) 553-6847 or (703) 487-4650

